# Squishy Circuits

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## TOOLS:

- Battery holder (1)
- crimping tool (optional) (1)
- soldering iron (optional) (1)

## PARTS:

- Batteries (4)
- Water (1 cup)
- LED (several)
- Flour (3 cups)
- Salt (¼ cup)
- Cream of tartar (3 Tbsp)
- Food coloring (1)
  *optional*
- Sugar (½ cup)
- Vegetable oil (4 Tbsp)
- Distilled water (½ cup)
  *or deionized water; check lab supply stores*
- (optional) motors or buzzers (1)

## SUMMARY

Making play-dough creatures is fun, but making them with light-up eyes and moving parts is even more enjoyable. We thought it would be better still if we could make the circuitry out of

the dough itself!

Most play dough is already conductive, but we needed a way to insulate the conductive dough. We came up with a sugar-based dough that works well as an insulator. It's pliable and resistant to blending with the conductive dough.

Rainy day and fidgety kids? Whip up both types of dough, gather some LEDs and batteries, and create your own menagerie of squishy circuit creations. Add a motor or two for sculptures with moving parts. Feeling adventurous? Play with the salt content of the recipes to vary their conductivity.

## Step 1 — Squishy Circuits

- Ingredients for conductive dough:
  - 1c water
  - 1½c flour
  - ¼c salt
  - 3Tbsp cream of tartar (or 9 Tbsp of lemon juice)
  - 1Tbsp vegetable oil
  - Food coloring (optional)

## Step 2



- Make the conductive dough.
- Reserve ½c flour, and mix the remaining ingredients in a medium-sized pot. Cook over medium heat, stirring continuously. The mixture will begin to boil and get chunky. Keep stirring until a ball forms in the center of the pot. Once a ball forms, turn off the heat and remove the dough to a lightly floured surface.
- CAUTION: The dough will be very hot! Flatten it and let it cool for a couple of minutes before handling.

- Slowly knead the remaining flour into the ball until you've reached the desired consistency.
- Store dough in an airtight container or plastic bag. In the bag, water from the dough will create condensation. This is normal. Just knead the dough after removing it from the bag, and it will be as good as new. Stored properly, it should keep for several weeks. If it dries out, just add a little more deionized water and knead it with some flour.

## Step 3

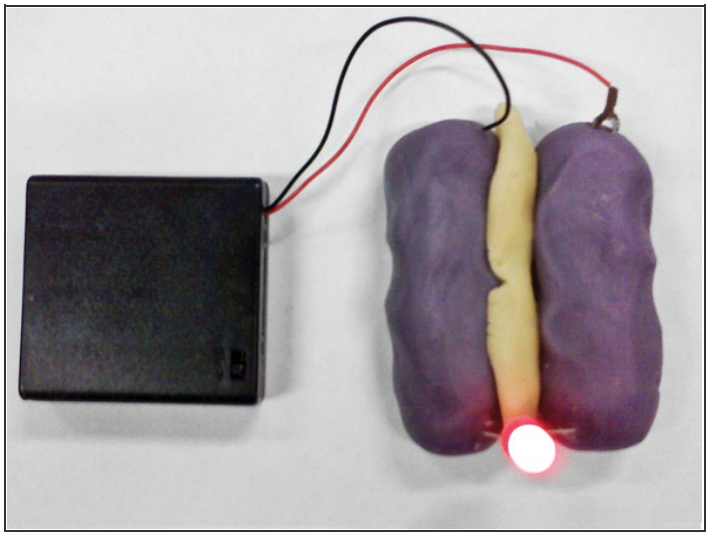
- Ingredients for the insulating dough:
  - 1½c flour
  - ½c sugar
  - 3Tbsp vegetable oil
  - ½c distilled or deionized water

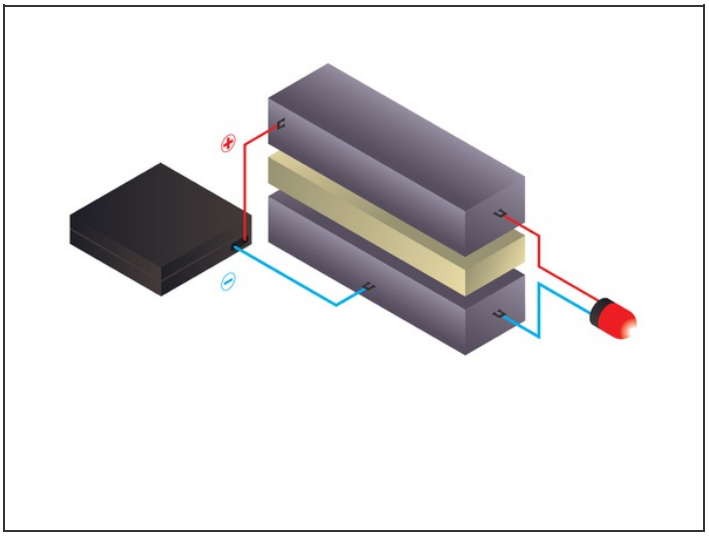
## Step 4 — Make the insulating dough.



- Mix the dry ingredients and oil in a pot or large bowl. Mix in 1Tbsp of deionized water and knead; repeat until the mixture becomes moist and dough-like.
- Remove the mixture from the pot or bowl, and slowly knead flour into it until it attains a firm consistency. You should use almost the entire ½c of flour.
- NOTE: You probably won't need more than ¼c of deionized water, but have ½c ready just in case.

## Step 5 — Make squishy circuits.





- Insert the 2 leads from the battery pack into 2 pieces of conductive dough, separated by a lump of insulating dough (we recommend using food coloring to differentiate the doughs).
- Insert an LED so its anode (long lead) is in the positive battery lump, and its cathode (short lead) is in the negative battery lump. It will light up!
- Always attach LEDs or other components to the dough. Never attach them directly to the battery pack, as running too much current through components can damage them, possibly causing them to overheat or pop.
- Note that this will work best if you attach leads to your battery pack's wires: http://courseweb.stthomas.edu/apthomas/S...
- More ideas for circuits that can be built using squishy circuits can be found here: http://courseweb.stthomas.edu/apthomas/S...

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